

# Ghana - Line Bifurcation

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# Overview

## Identification

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**COUNTRY**

Ghana

**EVALUATION TITLE**

Line Bifurcation

**EVALUATION TYPE**

Independent Evaluation

**ID NUMBER**

DDI-MCC-GHA-ENERGY-LINEBIF-GRDW-2020-v01

## Version

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**VERSION DESCRIPTION**

Edited clean data for internal use only

## Overview

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**ABSTRACT**

We are a team of engineers and economists currently engaged in two high-level activities. These include, designing and deploying a suite of low-cost technologies - GridWatch - to determine outage location and to measure outage duration, outage frequency, and voltage quality on the electrical grid. And using the data collected from the GridWatch sensors to measure the socioeconomic benefits of a reduction in outage duration and frequency and an increase in voltage quality as experienced by end-users. This will help us estimate customers' willingness to pay for reduced outages and increased voltage quality.

The team designed and is in the process of implementing an impact evaluation to measure the socioeconomic benefits of a reduction in outage duration and frequency and an increase in voltage quality as experienced by end-users. To do this, we use two sources of variation - priority feeders during the Dumsor period to create a differences in differences evaluation and the quasi-experimental variation associated with the Compact line bifurcation improvements - to estimate the causal effect of improvements in power reliability and quality on socioeconomic outcomes. First, we estimate the extent to which power reliability and quality affect firm and household electricity consumption directly through its impacts on the purchasing and usage patterns of electrical appliances or machinery. We then estimate whether this affects economic outcomes such as firm productivity, profits, or revenues, or household income.

At a high level, the team aims to measure primary Compact outcomes, including the frequency (SAIFI) and duration (SAIDI) of outages, and voltage level irregularities and then evaluate the socioeconomic impacts of improvements in those outcomes due to the Compact. Additionally, this study is set up to answer questions such as:

1. What are the economic and socio-economic benefits of access to reliable power on customers, including households and enterprises? How are these benefits distributed?
2. What happens within households and businesses when the power goes out? When it comes back on?
3. How long does it take households and businesses to make lumpy investments in power consuming technology when the reliability of the grid improves?
4. What is the Program's overall impact on the profitability and productivity of enterprises? What are the mechanisms or channels through which these impacts occur?
5. To what extent do firms respond to more reliable, accessible, and/or higher quality power by:

+Expanding or intensifying production

+Expanding employment

+Investing in expanded plant or other fixed assets and/or different production technologies reliant on electricity

6. Are customers notified ahead of schedule of their outages? What is the differential impact on customers between known and unknown outages? What is the impact of known versus unknown outages on customer relations?

7. To what extent are cross-customer variations in outages and voltage quality driven by politics versus profit maximization?

## EVALUATION METHODOLOGY

Difference-in-Difference

## UNITS OF ANALYSIS

Households, enterprises

## KIND OF DATA

Sample survey data [ssd]

## TOPICS

Topic	Vocabulary	URI
Energy	MCC Sector	

## KEYWORDS

Ghana, Electricity, Reliability, Grid, Power, Dumsor, Accra, Ghana Compact, Energy, Electricity Reform, Access, Energy Access

## Coverage

### GEOGRAPHIC COVERAGE

Survey participants are from the greater Accra region in Ghana.

### UNIVERSE

Household decision makers between the ages of 18-65 in Accra, Ghana

Enterprise decision makers between the ages of 18-65 in Accra, Ghana

## Producers and Sponsors

### PRIMARY INVESTIGATOR(S)

Name	Affiliation
University of California at Berkeley	University of California at Berkeley

### FUNDING

Name	Abbreviation	Role
Millennium Challenge Corporation	MCC	
Department for International Development	DFID	

## Metadata Production

### METADATA PRODUCED BY

Name	Abbreviation	Affiliation	Role
University of California at Berkeley	UC Berkeley	University of California, Berkeley	Independent Evaluator

**DATE OF METADATA PRODUCTION**

2020-03-20

**DDI DOCUMENT VERSION**

Version 1.0 (March 2020).

**DDI DOCUMENT ID**

DDI-MCC-GHA-ENERGY-LINEBIF-GRDW-2020-v01

## MCC Compact and Program

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**COMPACT OR THRESHOLD**

Ghana II Compact

**PROGRAM**

On August 5, 2015, MCC signed a \$535.6 million compact with the Government of Ghana (GOG). The Governments of the United States and Ghana contributed US\$498.2 million and US\$37.4 million, respectively. The Compact, the second with the GOG, aims to develop a more reliable and efficient electricity grid to support economic growth and poverty reduction. The Compact went into force on September 2016, and originally contained six projects: (1) the ECG Financial and Operational Turnaround (EFOT) Project to improve the quality and reliability of electricity through reduced outages, thereby improving utility financial health, credit-worthiness and cost effective service delivery; (2) the NEDCo Financial and Operational Turnaround (NFOT) Project to similarly develop NEDCo into a utility that can drive economic growth in Northern Ghana, (3) the Regulatory Strengthening and Capacity Building Project to promote greater transparency and accountability for results in the sector, and enhance evidence-based decision making among sector institutions; (4) the Access Project, which is designed to increase the number of new legal connections for small businesses in selected market centers, (5) the Energy Efficiency and Demand Side Management Project, which aims to reduce strain on the country's generation capacity by implementing four demand-side energy efficiency activities, and (6) the Power Generation Sector Improvement Project, which will support measures aimed at opening up Ghana's power sector to make it attractive to private investors for additional generation capacity. The Compact is scheduled to close on September 2021. Following the Mid-Term Review of the Program in February 2019, the NFOT and the PGSI Project were de-scoped, and the funds reallocated to the other projects, particularly the EFOT Project.

**MCC SECTOR**

Energy (Energy)

**PROGRAM LOGIC**

Unreliable power can be a major constraint to growth of businesses in Ghana. To effectively support the growth requirements of the economy, the Compact must address key challenges in the distribution of power. ECG, the leading distribution company in Ghana, incurs high technical and commercial losses, which deter private investment and may lead to low quality of service and higher cost of electricity service provision. The EFOT Project is designed to achieve short, medium, and long-term goals. In the short term, the Project will improve the financial sustainability of ECG by reducing commercial losses, improving billing and collection, ensuring cost reflective tariffs, implementing regular automatic tariff adjustments, and improving financial management generally within ECG. Ghanaians in the ECG Operational Area should experience improvements in power reliability and quality under EFOT through the reduction of unplanned outages and distribution technical losses, which will result in an improved voltage profile. Similarly, improvements in outage response time, reductions in the cost per kWh of electricity generation, and reinvestment and maintenance in capital expenditures will transform the operations management of ECG. Consequently, ECG will regain the ability to adhere to commercially agreed time limits for payments of bills to IPPs. However, vital institutional capacity building activities must complement the PSP option to achieve planned improvements in short term outcomes. In addition, sufficient infrastructure investments, including private sector participant contributions, are needed to achieve loss reduction targets within ECG. The medium term outcomes include improving the financial viability of ECG, positioning ECG as a credible off-taker, improving satisfaction among ECG customers, and enhancing investment capacity within ECG to achieve sustainable service delivery. Tariff reductions and improvements in power reliability and quality will reduce customers' reliance on diesel and petrol generators, resulting in an increase in electricity consumption from ECG. In the long term, more reliable and higher quality electricity service is likely to lead Ghanaian businesses in the ECG Operational Area to increase investments, expand their sales, and hire more employees. Achievement of this outcome under the EFOT Project, however, depends on coordinated actions from all other Compact program components, including sector expansion to meet demand. Deterioration in conditions under which businesses operate in Ghana (e.g., inflation, interest rates and credit availability, exchange rates) and other factors outside of the Compact scope may impact the likelihood of investment and deter private sector investment in the power sector.

# Sampling

## Study Population

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Household decision makers between the ages of 18-65 in Accra, Ghana Enterprise decision makers between the ages of 18-65 in Accra, Ghana

## Sampling Procedure

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We will implement a sampling strategy that aims to ensure that the sample is representative of the broader sample unit population. Both firm and household sampling will be based on a random walk method. Surveyors will be assigned to interview a certain number of households or firms, and then given a randomly determined starting point within a survey site. At that point, surveyors will flip a coin to determine in which direction to walk or which side of the road to walk on. If targeting households, surveyors will approach the first household they encounter, and afterward (after either completing the survey, finding the household is not eligible for the survey, or if the household refuses to participate) continue walking in the same direction and approaching every 3rd or 4th household they encounter depending on the assigned site. If enumerators approach the site boundary or the end of a road and cannot continue along a road within the site boundary, they should return to the starting point and repeat the process. If targeting firms, surveyors will follow the same protocol but approaching and counting firms rather than households.

## Deviations from Sample Design

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The Priority feeder sample includes fewer priority (exempt) sites than ordinary (non-exempt) sites. As such, surveyors will sample every 3 structures in priority sites and every 4 structures in ordinary sites. All other parts of the survey protocol remain identical in all sites and across the line bifurcation study.

## Response Rate

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Unknown because data not yet collected.

## Weighting

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Unknown because data not yet collected.

# Questionnaires

## Overview

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Primary household Questionnaire - We collect data via questionnaire on household ownership of appliances, electricity consumption, and purchase and use of generators and electricity protection devices. We also collect basic household sociodemographic information, including age, gender, education, and income for all household members. We will assess the data for coding inaccuracies and compare our survey data to secondary data from the Ghana Living Standards Survey that is collected by the Ghana Statistical Service.

Primary firm questionnaire - We collect data via questionnaire on firm characteristics such as date of establishment, number of employees, hours of operation, ownership of appliances, electricity consumption, and purchase and use of generators and electricity production devices. We will assess the data for coding inaccuracies and compare our survey data to data from the Non-Farm Enterprise Questionnaire of the Ghana Living Standards Survey and to data from the Integrated Business Establishment Survey.

Questionnaires are to be administered verbally in English or the respondents preferred local language with responses being recorded in English to the tablet based SurveyCTO program. All respondents will be between the ages of 18-65 and must be a key decision maker in the household or firm.

## Data Collection

### Data Collection Dates

Start	End	Cycle
2020-06	2020-08	N/A

### Data Collection Notes

Unknown because data not yet collected.

### Questionnaires

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### Data Collectors

Name	Abbreviation	Affiliation
Institute of Statistical, Social, and Economic Research	ISSER	University of Ghana

### Supervision

The socioeconomic survey is to be conducted by 20 enumerators, 5 field supervisors, and one back checker from ISSER's pool of candidates. Each supervisor has a team of 4 additional enumerators meaning each team has 5 surveyors. Each team has at least 1 female and 1 enumerator who speaks the lesser spoken local language "Ga".

Supervisors act as middlemen between field enumerators and the project managers at both ISSER and UC Berkeley. They handle any minor glitches that occur in the field and are responsible for the safety of their team, community entry before beginning a new site, and for ensuring that the groups weekly quotas are met. Supervisors are responsible for collecting 5 surveys per week on top of their supervising responsibilities. Weekly meetings will also be held between supervisors and the ISSER project manager.

Enumerators collect surveys individually, but work with team goals in mind. Each team of 4 enumerators is expected to collect 70 surveys per week (75 including the supervisor's surveys).

The back checker randomly selects and contacts survey participants via phone. The point of this is to quality check key indicators for the evaluation and ensure that enumerators are truthfully distributing the post-survey incentives and conducting the survey properly.

# Data Processing

## Data Editing

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Both the ISSER and UC Berkeley project managers conduct regular checks on the socioeconomic survey data.

- Data is pulled from SurveyCTO daily and put into Stata format
- Project managers then run a preset .do file built on top of the cleaning file provided by SurveyCTO.
- File includes checks for completeness, timing, and accidental repeated data.
- In depths weekly or monthly checks will take place. Content to be determined when collection has begun.

## Other Processing

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Data is entered directly on tablets into the SurveyCTO program by our 20 enumerators and 5 field supervisors. Surveys are saved locally immediately after each survey and uploaded to the cloud server each evening when enumerators make it to wireless internet connection. We have programmed the survey so that essential questions cannot be skipped or the enumerator cannot move forward to the next question. We have also built in mapping and GPS capabilities to ensure that the enumerators verify that they are within the survey site before even approaching the respondents. The program codes all data and prepares it for export into .csv. The program includes a cleaning file to make data easily usable in Stata.



## Data Appraisal

### Estimates of Sampling Error

Unknown because data not yet collected.